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CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—NO. LXXXVII

(*Continued from p. 57.*)

IV. THE COMPLEX BROMUS CILIATUS

M. L. Fernald

(Plate 196)

Bromus **Dudleyi**, n. sp. (Tab. 196, figs. 1–3). Planta noncaespitosa vel plus minusve caespitosa 0.4–1.2 m. alta; culmis erectis glabris nodis sparse breviterque pilosis; foliis caulinis plerumque 6 late linearibus utrinque glabris vel paginis superioribus villosis, vaginis glabris vel rare villosis, laminis mediis 1–2.5 dm. longis 4–12 mm. latis; paniculis lanceolatis vel ovatis laxe ramosis 0.6–2 dm. longis, ramis filiformibus scabris remotis adscendentibus vel patentibus vix pendulis; spiculis lanceolato-oblongis vel anguste ellipticis 2–2.5 cm. longis 5–9 mm. latis 4–7-floris; glumis planiusculis vix conduplicatis submembranaceis, marginibus scariosis purpureo- vel aeneo-tinctis; gluma inferiore lanceolata acuta vel attenuata late costata, costa laevi vel scabra; gluma superiore oblongo-lanceolata obtusa vel subacuta plerumque breviter aristata valde lateque 3 (rarissime 5)-costata, costis brunneis vel purpurascentibus; lemmatibus planiusculis submembranaceis anguste oblongis aristis exceptis 1–1.2 cm. longis 2.3–3 mm. latis purpurascentibus aeneis vel rare virescentibus obtusis vel subacutis apice aristatis arista scabra 2–4 mm. longa, paginis dorsalibus 3–5-nervatis in parte extra nervos laterales valde villoso-hirsutis ad vel supra medium; palea plana oblonga quam lemma breviore, marginibus infra apicem plerumque scariosis 0.5–0.7 mm. latis integris, nervis ciliolatis infra a marginibus et a medio sub-aequidistantibus ad apicem versus marginalibus; antheris 1–2 mm. longis; caryopsibus oblongo-lanceolatis 8 mm. longis 1.6 mm. latis, latere ventrali valde costato.—Newfoundland to British Columbia, south to Nova Scotia, northern and western New England, New

York, Michigan, Minnesota and Montana. Newfoundland: bushy swale along Deer Brook, Bonne Bay, August 26, 1929, *Fernald, Long & Fogg*, no. 1223 (type in Gray Herb.); boggy thickets, Birchy Cove (Curling), *Fernald, Wiegand & Kittredge*, no. 2624 (in part); gravelly railroad embankment, Grand Falls, *Fernald, Wiegand & Darlington*, no. 4679; gravelly thickets along Harry's River, *Fernald & Wiegand*, no. 2617; wet runs and boggy spots in limestone barrens, Table Mountain, Port à Port Bay, *Fernald, Wiegand & Kittredge*, no. 2619. Quebec: wet thicket, Ile du Havre, Mingan, *St. John*, no. 90,166; alluvial thickets, Dartmouth River, August 26 & 27, 1904, *Collins, Fernald & Pease;* gravel of River Ste. Anne des Monts, August 3–17 1905, *Collins & Fernald;* alluvial islands at the mouth of Bonaventure River, August 4, 1904, *Collins, Fernald & Pease:* alluvial thickets and low wooded river-banks, Little Cascapedia River, July 29 & 30, 1904, *Collins, Fernald & Pease;* Kondiaronk, Lac Saint-Jean, *Victorin*, nos. 15,265, 15,266; Lac Noir, Co. Megantic, *Victorin*, no. 11,369. Prince Edward Island: damp thicket, Indian River, *Fernald, Long & St. John*, no. 6931. Nova Scotia: gravelly thicket, Uniacke Lake, *Fernald, Bartram & Long*, no. 23,335. Maine: dry field, outlet, Pleasant Pond, *Collins & Chamberlain;* moist soil, Beddington, September 2, 1924, *Knowlton;* wet place, Rockland, *C. A. E. Long*, no. 660; river-thickets, Sydney, *Fernald & Long*, no. 12,718. New Hampshire: boggy meadow, Clarkesville, *Fernald & Pease*, no. 17,050; moist woods, Glen Ellis, Pinkham Notch, July 23, 1921, *Knowlton;* damp woods, Melvin Village, August 23, 1904, *M. A. Day.* Vermont: damp place, Townshend, July 25, 1903, *Blanchard.* Massachusetts: edge of woods, Sherborn, *M. L. Loomis*, no. 1360; roadside, Princeton, August 9, 1894, *J. F. Collins;* Ashfield, August 3, 1909, *E. F. Williams* (type of *B. ciliatus*, forma *denudatus*); Heath, July 17, 1909, *E. F. Williams;* roadside thicket, Tolland, *F. C. Seymour*, no. 335; open bog, Lanesboro, August 4, 1920, *R. Hoffmann.* Connecticut: Hampton, August 11, 1888, *Chas. Wright* (with comment: "lower glume with faint lateral nerves"); dry bank, Lisbon, August 26, 1902, *C. B. Graves.* New York: open sedgy bog, Round Marshes, Cortland, *Eames & MacDaniels*, no. 159; boggy meadow near headwaters of Beaver Brook, Cortland, *F. P. Metcalf*, no. 5814 (distributed as *B. ciliatus*, var. "Very characteristic bog form"); open moor of Lowery's Pond, Junius, *Metcalf*, nos. 1727 and 5815 ("Swamp variety"); Ontario: Leamington, *J. Macoun*, no. 26,058. Michigan: swamps, Keweenaw Co., *Farwell*, no. 562a (with note: "hairs of glumes *spreading*, not *appressed*"). Minnesota: Muskoda, Red River Valley, *Ballard*, no. 3075. Saskatchewan: margins of lakes and streams, Moose Mountain Lake, August 5, 1883, *J. Macoun.* Montana: East Gallatin swamps, *Rydberg*, no. 3170. British Columbia: Mile 81, Pacific Great Eastern Ry., *J. M. Macoun*, no. 94,021.

Bromus Dudleyi has been confused with and usually distributed as

B. ciliatus L.; but *B. ciliatus*, the commonest species of thickets and borders of woods in eastern Canada and the northeastern States has, when well developed, a larger and greener panicle with more pendulous branches. Its well developed spikelets (FIGS. 4 and 5) are so open as plainly to show the slender rhachilla, while in *B. Dudleyi* the lemmas are so approximate that the short internodes of the rhachilla are difficult to see. *B. Dudleyi* matures early. Of the 60 sheets before me not one has young or freshly flowering spikelets; all are in fruit or so mature that the spikelets are disintegrating and nearly all were collected at dates ranging from July 17 through August, with only four (overripe) collections in the first half of September. *B. ciliatus*, on the other hand, as shown by a very extensive series, especially from Newfoundland and eastern Canada and New England, is rarely in anthesis before the middle of July, when *B. Dudleyi* is becoming mature. The large representation of *B. ciliatus* before me shows that in New England, eastern Canada and Newfoundland it is in flower (the spikelets not readily disintegrating) from mid-July into September, and that the fruiting material had been collected from August 11 through September.

In habitat *Bromus Dudleyi* shows a marked preference for (though not restriction to) limy or neutral bogs and wet thickets, being specially characteristic of the calcareous regions of Newfoundland, the Mingan Islands, the Gaspé Peninsula, western New England, central New York, etc. It is the plant which the late W. R. Dudley specially designated in his Cayuga Flora, as

> 1256. **B. ciliatus,** L. var. ——, approaching some of the Rocky Mt. forms (according to Dr. Vasey,) occurs in our sphagnum bogs or wet meadows. The plants are low, light-green; the panicle peculiarly chaffy in appearance, light-colored, and the flowering glumes smooth on the back but strongly ciliate. It is abundant, in Round Marshes, along Locke Pond and elsewhere.[1]

Its occurrence in the calcareous bogs of central New York was again emphasized by Wiegand, who mistook the bog-plant for *Bromus ciliatus:* "In central New York *B. ciliatus* is generally an inhabitant of marl springs and calcareous boggy places. In other portions of its range it does not seem to be confined to boggy places or even to calcareous situations, yet no structural difference is apparent between the New York material and that from elsewhere."[2] And later, Wiegand & Eames referred to this early-maturing plant of wet habitats as growing

[1] Dudley, Cayuga Fl. 129 (1886).
[2] Wiegand, RHODORA, XXIV. 91 (1922).

in the Cayuga Basin in "Boggy meadows and springy places, in marl or strongly calcareous soils; frequent. July–Aug."[1]

When he published *Bromus ciliatus*, forma *denudatus* Wiegand, Rhodora. xxiv. 91 (1922), Wiegand merely distinguished from *B. ciliatus* with sheaths villous the plants with sheaths glabrous and he separated off in the Gray Herbarium two covers full of such specimens (most of them with all the spikelet-characters of *B. ciliatus*), stating that the smooth-sheathed form occurs "Throughout the range of the typical form"; but he specially designated as the type a single specimen "Ashfield, Massachusetts, 1909, *E. F. Williams.*" The type-specimen was an unfortunate selection, for it is an over-ripe specimen with the spikelets completely disintegrated. It was collected on August 3d and the fragments seem to indicate that the type of forma *denudatus* belongs to *B. Dudleyi.* Somewhat later, still not understanding the differences in the spikelets which separate *B. Dudleyi* and *B. ciliatus,* but conscious that glabrous-sheathed plants are more general in the North than are those with villous sheaths, I elevated the form to varietal rank as *B. ciliatus*, var. *denudatus* (Wiegand) Fernald, Rhodora, xxviii. 20 (1926). Since the conceptions back of *B. ciliatus*, forma *denudatus* and var. *denudatus* were mixed, since their technical type is a specimen with badly shattered panicle and since forms with villous or with glabrous (denudate) sheaths occur in our other species of the group (*B. ciliatus, B. Richardsoni, B. altissimus, B. purgans*, etc.) it would be unwise further to elevate the name. The International Rules of Nomenclature make no requirement that a name appropriate in one category shall necessarily be retained when the rank is changed, particularly if it is a *nomen confusum.* It seems right, therefore, to give this belated recognition to the acumen of the late William Russell Dudley, who nearly half a century ago clearly recognized the distinctness of the plant here proposed as *B. Dudleyi*, and to designate as a type a numbered specimen of unquestioned identity.

The specific distinctions between *Bromus Dudleyi* and *B. ciliatus* are briefly stated below:

B. ciliatus. Panicles (except in dwarf plants) 1–3 dm. long, with more or less nodding branches: spikelets green or greenish, rarely purple- or bronze-tinged, at maturity loose, displaying the rachilla: glumes strongly conduplicate; the 2d narrowly lance-attenuate, 3-nerved, the greenish nerves very slender: lemmas subcoriaceous, conduplicate or involute, lance-attenuate, with very delicate nerves; the marginal band appressed-pilose to sericeous or glabrous: palea linear, usually closely embraced by

[1] Wiegand & Eames, Fl. Cayuga L. Basin, 61 (1926).

the strongly folded lemma; the green and ciliate ribs marginal their entire length, the hyaline border abruptly folded toward the middle of the palea: caryopsis linear-lanceolate.

B. DUDLEYI. Panicles 0.6–2 dm. long, their branches scarcely nodding: spikelets mostly purple- or bronze-tinged, rarely green, with crowded lemmas; the rachilla usually hidden: glumes flattish or merely dorsally rounded; the 2d with coarse colored nerves: lemmas flattish, submembranaceous, oblong, obtuse to subacute, strongly nerved; the marginal band conspicuously villous-hirsute especially below the middle: palea oblong, flat, scarcely embraced by the lemma; the ciliolate nerves midway between the entire margin and the middle except at the tip where they become marginal: caryopsis oblong-lanceolate.

These contrasts are brought out in the plate, for which I am indebted to Dr. H. M. Raup and Mr. A. N. Steward, showing spikelets of *B. ciliatus* (FIG. 4) and its variety (to be discussed in succeeding paragraphs) (FIG. 5) and a panicle (FIG. 1), spikelet (FIG. 2) and palea (FIG. 3) of *B. Dudleyi* from the type-collection of that species. For comparison, spikelets of *B. Kalmii* (FIG. 7), *B. Porteri* (FIG. 6) and *B. ramosus* (FIG. 8) are also shown.

Bromus Dudleyi (FIGS. 1–3), as Dudley (quoting Vasey) stated, is nearer related to some Rocky Mountain plants than to true *B. ciliatus* (FIGS. 4 and 5). It occurs itself in British Columbia and Montana and doubtless elsewhere in the Rocky Mountains, where its nearest relative is *B. Porteri* (Coult.) Nash (FIG. 6), but that species has the panicle much looser and the lemmas densely pubescent over their entire surfaces, much as in *B. Kalmii* Gray (FIG. 7) of usually dry soils of the eastern United States. The western specimens of *B. Dudleyi* have been called *B. Richardsoni* Link, but that species closely simulates *B. ciliatus* in its strongly folded or conduplicate and silky-margined lemmas. In habit, early flowering, short cauline leaves, flattish lemmas and flat-margined paleas *B. Dudleyi* is equally close to *B. Kalmii* (FIG. 7), but the latter species of mostly dry habitats from southwestern Maine southward and westward is at once distinguished by the extreme pubescence of its spikelets, shorter and broader lemmas, with shorter awns and more numerous and more prolonged nerves, and narrower paleas with pilose or almost villous nerves.

The original locality of *Bromus canadensis* Michx. Fl. Bor.-Am. i. 65 (1803), recorded on the label as Lake St. John, and Michaux's characters, "foliis rariter pilosis: . . . florum valva exteriore . . . versus margines villosa," suggest that *B. Dudleyi* might be *B. canadensis*. Michaux, however, apparently collected the latter late in the season, long after *B. Dudleyi* is mature ("Le 12 Septembre

. . . arrivé . . . au Poste du lac St Jean . . . Le 13 j'ay herborisé aux environs du Lac."—Journ. André Michaux, ed. Sargent, 85, 86). The other characters given by Michaux might belong to either *B. ciliatus* or *B. Dudleyi* but, fortunately, in the series of fragments of types accumulated by Professor Hitchcock at Washington there is a spikelet of the type of *B. canadensis*. This spikelet, most kindly loaned me for study by Dr. Jason R. Swallen, is not only young but thoroughly characteristic of the late-flowering plant generally accepted as *B. ciliatus*.

Bromus ciliatus L. When I took up[1] *Bromus ciliatus*, forma *denudatus* Wiegand[2] as var. *denudatus*, I pointed out that the plant with glabrous or nearly glabrous median and upper sheaths is far more abundant northward and far less abundant southward than the plant with densely retrorse-villous sheaths. After the removal from the former series of *B. Dudleyi* it becomes important again to note the relative abundance of the two extremes left in *B. ciliatus*. The material before me (in the Gray Herbarium and the herbarium of the New England Botanical Club) shows the following contrasts in relative abundance.

	Labrador Peninsula (Straits of Belle Isle and Cote Nord to James Bay)	Anticosti I. and Gaspé Peninsula	Newfoundland	New Brunswick	Nova Scotia	Southwestern Quebec (Temiscouata Co. to Eastern Townships)	Maine	New Hampshire	Vermont	Massachusetts	Connecticut	New York
Middle and upper sheaths glabrous or only remotely and sparsely pilose	6	30	31	6	8	3	33	14	8	8	0	0
Sheaths densely pilose or villous	0	0	3	3	3	5	45	27	14	16	8	6

Besides being generally more northern, the plant with glabrous or nearly glabrous sheaths shows a strong subalpine tendancy, occurring on the high escarpments of western Newfoundland, on the subalpine meadows (alt. 900–1125 m.) of the Shickshock Mts. of Gaspé, on the Fan of Huntington's Ravine (alt. 1372 m.) on Mt. Washington, New Hampshire, and on the famous cold and subalpine slides of Willoughby, Vermont; it also occurs at the summit of Roan Mt. (alt. 1917 m.),

[1] Fernald, Rhodora, xxviii. 20 (1926).
[2] Wiegand, Rhodora, xxiv. 91 (1922).

North Carolina. Contrasted with this strong subalpine tendency of the smoother plant is the fact that, of the plant with densely villous or pilose upper sheaths not a single specimen from Newfoundland to Ontario and Connecticut has been collected at any appreciable altitude. Furthermore, while the marginal pubescence of the lemmas in the plant with villous upper sheaths is delicate and appressed-sericeous, the pubescence of the lemma in the more boreal glabrous-sheathed extreme is more variable, sometimes appressed-sericeous but more often coarsely pilose. The characteristically pilose-margined lemma and the smooth sheaths are well brought out in the illustration of *B. ciliatus* in Shear, Revis. N. A. Sp. Bromus, fig. 16.[1] Shear did not attempt to differentiate the two extremes of *B. ciliatus*, but Wiegand, in breaking up the species defined his conception of typical *B. ciliatus* as having "Sheaths villous; blades usually hairy," while his forma *denudatus* has "Sheaths glabrous or the lowermost slightly villous; blades usually glabrous."[2] Wiegand's interpretation was accepted unquestioned when I elevated his forma *denudatus* to var. *denudatus*.[3] But, as already pointed out, the designated type of forma or var. *denudatus* is not conspecific with the bulk of the material with glabrous upper sheaths; consequently it is necessary to look anew into the proper names for the varieties of *B. ciliatus*.

The original description of *Bromus ciliatus* L. was as follows:

> *ciliatus*. 4. BROMUS panicula nutante, foliis utrinque vaginisque subpilosis, glumis ciliatis.
> *Habitat in* Canada; *ex semine. D. Kalm.*
> *Culmi tenues. Folia utrinque & vaginae vix manifeste pubescentes. Panicula valde nutans, non crispis pedunculis. Spiculae oblongae, compressae, petalorum marginibus (non dorso) valde pilosis, qua nota facile distingvitur. Flosculi 8, sub apice aristati; calyces nudi. Glumae corollae lanceolatae.*[4]

According to Hitchcock[5] there is nothing in the Linnean herbarium which has the glumes glabrous on the back ("petalorum marginibus (non dorso) valde pilosis") and which can, therefore, be considered a "type." He consequently concluded that we should retain the name *B. ciliatus* for the plant as treated in Shear's monograph. This seems the proper course; and since Shear, in monographing the genus, specially illustrated the plant with glabrous sheaths and pilose-

[1] U. S. Dept. Agric. Div. Agrost. Bull. No. 23: 32, fig. 16 (1900).
[2] Wiegand, Rhodora, xxiv. 90 (1922).
[3] Fernald, Rhodora, xxviii. 20 (1926).
[4] L. Sp. Pl. i. 76, 77 (1753).
[5] Hitchcock, Contrib. U. S. Nat. Herb. xii. 122 (1908).

margined lemmas, this extreme should be taken to stand as true *B. ciliatus*. Fortunately, this is the commoner variety in Canada, whence Kalm secured the seed; and the emphatic statements of Linnaeus that the "sheaths are scarcely manifestly pubescent (vaginae vix manifeste pubescentes)" and that "the margins of the lemmas are conspicuously pilose (petalorum marginibus (non dorso) valde pilosis, qua nota facile distingvitur)" make it reasonably clear that Shear's illustration truly embodies[1] the important characters of the Linnean plant. This interpretation, that Linnaeus had the common plant of northeastern Canada with scarcely pubescent sheaths gains support from the fact that, in the *Species Plantarum*, *B. ciliatus* with "vaginae vix manifeste pubescentes" came immediately after Linnaeus's other American species, *B. purgans*, in which the sheaths are rarely so pubescent as in the villous-sheathed extreme of *B. ciliatus*. Yet Linnaeus described *B. purgans* as having "*Vaginae foliorum retrorsum pilosae.*" *B. canadensis* Michx. seems to have been based on small specimens of true *B. ciliatus*.

For the less boreal plant with villous sheaths I find no published name. I am therefore designating the two varieties as follows:

Bromus ciliatus L., var. **genuinus.** *B. ciliatus* L. Sp. Pl. i. 76 (1753). *B. canadensis* Michx. Fl. Bor.-Am. i. 65 (1803). *B. ciliatus* Shear, U. S. Dept. Agr. Div. Agrost. Bull. No. 23, fig. 16 (1900). *B. ciliatus*, forma *denudatus* Wiegand, Rhodora, xxiv. 90 (1922), in large part but not as to type. *B. ciliatus*, var. *denudatus* (Wieg.) Fern. Rhodora, xxviii. 20 (1926), in large part but not as to type.—Middle and upper sheaths glabrous or nearly so: margin of lemma pilose to sericeous.—Newfoundland and southern Labrador Peninsula to Manitoba, south to Nova Scotia, Massachusetts, northern Ohio, Michigan, Wisconsin and North Dakota, often ascending to subalpine areas; Roan Mt., North Carolina.

Var. **intonsus,** n. var., vaginis mediis superioribusque villosissimis vel valde retrorse-pilosis; lemmatis marginibus sericeis.—Newfoundland and southern Quebec to southern Ontario, south at low altitudes to Pennsylvania and Michigan. Type: Ashfield, Massachusetts, August 4, 1909, *E. F. Williams* (in Gray Herb.).

All the older sheets of *B. ciliatus* var. *intonsus* in the Gray Herbarium were labeled in the hand of William Boott or of Asa Gray *B. asper;* and this variety formed the basis of the entry in Gray's Manual, ed. 5, of *B. asper* from "Bethel, Maine, in fields along the river-bank, *W. Boott.* (Nat. from Eu.)"[2] and the more ample range in

[1] Except for the superabundance of lemmas.

[2] Gray, Man. ed. 5: 635 (1867).

ed. 6: "N. Brunswick to Mich. and Ky. (Nat. from Eu.)."[1] The record was taken over by Britton & Brown and in their Illustrated Flora, ed. 2, is entered as "In waste places, New Brunswick to Michigan and Kentucky. Naturalized from Europe."[2] That William Boott and Asa Gray were not quite convinced that the plant they called *B. asper* was really an introduction is shown by the penciled memoranda in Gray's hand, obviously inspired by the field knowledge of Boott, on some of the labels: "native"; nevertheless this pertinent and most important item did not find an entry into the Manual. In his monographic study of the genus in North America, Shear, taking up for *B. asper* Murr. (1770) the earlier name *B. ramosus* Huds. (1762), said: "A species introduced from Europe. It is said in Britton and Brown's 'Illustrated Flora' to be distributed from New Brunswick to Michigan and Kentucky. We have no American specimens in the National Herbarium."[3] Had he realized the sources of Gray's and Britton & Brown's records, Shear could have added that there were no American specimens of *B. ramosus* (*B. asper*) extant and that the original identification was an error; for *B. ramosus* of Europe (FIG. 8) differs from the American plant mistaken for it in its pubescent culms, narrower and much prolonged panicle, more remote and longer lemmas with longer awns, and anthers very much longer (4 mm. long).

EXPLANATION OF PLATE 196

(Figures × 1¾)

FIG. 1, panicle of BROMUS DUDLEYI (from type-number); FIG. 2, spikelet of B. DUDLEYI; FIG. 3, inner face of lemma, showing flat palea; FIG. 4, spikelet of B. CILIATUS, var. GENUINUS from Table–top Mountain, Quebec (*Fernald & Collins*, no. 169); FIG. 5, spikelet of B. CILIATUS, var. INTONSUS from the type; FIG. 6, B. PORTERI from type-locality, Twin Lakes, Colorado (*Wolfe*, no. 807); FIG. 7, B. KALMII from the assumed type, Troy, New York, *Asa Gray;* FIG. 8, B. RAMOSUS (*B. asper*) from Bavaria (*Fl. Exsicc. Bav.* no. 597).

V. SOME VARIETIES OF THE AMPHIGEAN SPECIES OF OSMUNDA

M. L. FERNALD

THREE species of Osmunda are found on both of the northern continental masses, Eurasia and North America. One of them extends into tropical South America, another into subtropical and tropical

[1] Wats. & Coult. in Gray, Man. ed. 6: 670 (1890).
[2] Britton & Brown, Ill. Fl. ed. 2, i. 275 (1913).
[3] Shear, U. S. Dept. Agric. Div. Agrost Bull no. 23: 30 (1900).

Africa, and five additional species are Asiatic endemics and a sixth South American. In a recent attempt to determine the degree of identity or of segregation of the three amphigean species in the Northern Hemisphere certain parallel variations in the three which apparently have not been generally recognized by students of the ferns have come to my attention.

Osmunda regalis and its var. spectabilis. For more than a century systematists have wavered in their estimate of the American *Osmunda regalis* L., sometimes treating it as a species, *O. spectabilis* Willd. Sp. Pl. v. 98 (1810), sometimes as an American variety, *O. regalis*, var. *spectabilis* (Willd.) Gray, Man. ed. 2: 600 (1856), and often as not separable from the European type. In European descriptions *O. regalis* is very generally stated to be 4 to 6 feet (1.2–1.8 m.) high and most accounts tell of exceptional colonies reaching a height of 12 feet (3.6 m.), but in dry or sterile habitats and toward the northern limit of its range the European plant may be only 2–4 feet (0.6–1.2 m.) high, and in the dwarf var. *pumila* Milde it is extraordinarily low, only 9 inches (2.2 dm.) high. The plant of eastern North America (Newfoundland to the Saskatchewan, south to Florida and Texas) certainly reaches no such height as 3.6 m. (12 feet); in fact, the measurements with us were accurately stated by the late D. C. Eaton when he wrote: "The fronds of the royal fern are said to attain the height of ten or eleven feet in the British Islands; but the highest I have ever seen were from the valley of the Connecticut River, and measured six feet from the ground. Fronds four or five feet high are not at all rare; but more commonly the fronds, including the stalk . . . stand from two to four feet high. In dryish marshes they are often not more than a foot or fifteen inches high."[1] Had Eaton seen the American plant at the northeastern limit of its range, in eastern Quebec and Newfoundland, he would have brought his minimum measurements down even lower than those of the European var. *pumila*, for on the barren slopes of western Newfoundland, in eastern Quebec and at the altitudinal limit of the fern on Mt. Katahdin, Maine, it is often less than 8 inches (2 dm.) high. Surely, if there were any truth in the oft-repeated tale of Osmund, the ferryman, hiding his wife and daughter in the shade of the Royal Fern, it is clear that the dramatic incident would find greater probability when linked to the tall extreme of the European plant than it would if visualized as occurring in the tell-tale shade of our low American representative of it!

[1] Eaton, Ferns N. Am. i. 213 (1879).

Numerous characters, narrower and more remote pinnules without basal auricle, finer serrulation, the presence of a bloom, and more slender fruiting panicles, have been emphasized as distinguishing *O. spectabilis* from *O. regalis;* but, although extreme specimens are easily separated, these points are by no means constant and apparently identical pinnules with or without auricles can be found on either continent, while bright-green and glaucous plants are both common with us. The generally lower stature and generally more slender or more delicately branched panicle of the American plants seem to be real tendencies; and in studying the plants of the two continents I find another character which has either been overlooked or not much stressed. On the rachises of the fruiting panicles of true *Osmunda regalis* I find numerous rather persistent black scale-like trichomes; on the rachises of the panicles of *O. spectabilis* I find none of them or, at most, a few elongate axillary hairs. This difference is so real in all material fit for comparison that, combined with the other strong, though far from constant tendencies of the plants it may be taken as the diagnostic character of a reasonably good geographic variety. I am, therefore, maintaining our plant as O. REGALIS L., var. SPECTABILIS (Willd.) Gray.

O. CLAYTONIANA AND ITS VAR. VESTITA. It is generally stated that *Osmunda Claytoniana* L. has three disrupted areas of distribution: eastern North America (Newfoundland to Lake Mistassini and Lake Winnepeg, south to North Carolina, Kentucky and Missouri), eastern Asia (Japan and Corea to the Himalayas) and Brazil. The plant of North America has the very young fronds more or less wooly with whitish-brown tomentum. This is promptly deciduous and persists on the older fronds only as cobwebby remnants, but always of a pale-brown color. The plant of the Himalayan region, however, has more abundant and, apparently, more persistent wool of a strong ferruginous color.

The name of the Himalayan variety is OSMUNDA CLAYTONIANA, var. VESTITA (Wall.) Milde, Monogr. Gen. Osmundae, 102 (1868). Wallich, Cat. no. 52 (1829) had the *nomen nudum:* "*Osmunda monticola*, Wall. Kumoon, R. B.," followed by "*β. vestita, frondibus apice fertilibus.*" In 1833, Wallich's no. 52, recorded by him as *O. monticola*, collected in Kumoon by Robert Blinkworth ("R. B."), was formally described by Greville & Hooker as

3. O. pilosa *Wall.*
   Frondibus ovato-lanceolatis pinnatis (junioribus densissime ferrugineo-lanatis) . . . —*Wall. Cat. No.* 52.

Hab. Rio Janeiro, *Dr. Wallich.*—This is very closely allied to *O. interrupta* of North America, which differs, however, ... in its glabrous fronds; but, if we are not mistaken, the latter is covered in a young and recent state with a ferruginous down, in which case we scarcely know how the present plant is to be distinguished, except by its larger size, and denser pinnae, ..."[1]

Osmunda monticola Wall. was unquestionably a *nomen nudum* but his var. *vestita* of it had a phrase of description. Greville & Hooker definitely described no. 52, not as *O. monticola*, but as *O. pilosa* (ascribed to Wallich), "Frondibus . . . junioribus densissime ferrugineo-lanatis." This characterization is correct for all Himalayan material I have seen; and since Milde, although not distinguishing the Himalayan plant in general from the American, took up *O. monticola*, *β. vestita* Wall. Cat. no. 52 as *O. Claytoniana*, var. *vestita* (Wall.) Milde, Monogr. Gen. Osmund. 102 (1868), we may use that varietal name for all the Himalayan plants. Var. *vestita* was intended technically as the name for an unusual form hardly worthy varietal recognition, but, here extended, it covers the Himalayan plant with rufescent wool, as contrasted with true *O. Claytoniana*, in which the wool is whitish-brown. Whether the plant of easternmost Asia is all the same as the Himalayan I cannot say, as the Asiatic material in the Gray Herbarium is all from the Himalayan area; but the Asiatic plant is presumably all of a single variety. The material from the high mountains of Yunnan, at least, seems to be var. *vestita*, for Dr. Christensen, taking it to be a new variety, has published it as var. *lanosa* Ch. Christens. in Levéillé, Cat. Pl. Yun-nan, 107 (1916), with the description identical in substance ("Rachis ut in O. cinnamomea L. tomento rufo densissime tecta") with that of the earlier *O. pilosa* Wall. which was based on Wallich's no. 52, which was also the type of *O. Claytoniana*, var. *vestita* (Wall.) Milde.

The habitat "Rio Janeiro," given by Greville & Hooker for Wallich's plant has been thoroughly misleading. In his *Monographia Generis Osmundae* (1868), Milde gave the range of *O. Claytoniana* as **"Nord America:** . . . **Süd Amerika:** Rio Janeiro. (Wallich). **Asia"**; and in his *Ferns of North America* (1879), Eaton said "has been attributed to Brazil, near Rio Janeiro, though probably by an error of Wallich's."[2] The error was not Wallich's, however, but Greville & Hooker's. Wallich clearly gave his no. 52 as coming from Kumoon; but the next following, no. 53, *Aneimia flexuosa*, was listed as coming from "Rheo Janeiro 1807." It is obvious that, in copying, Greville

[1] Grev. & Hook. in Hook. Bot. Misc. iii. 229 (1833).
[2] Eaton, Ferns N. A. i. 220 (1879).

& Hooker passed over the correct locality and collector of no. 52, the basis of *O. pilosa* and of *O. Claytoniana*, var. *vestita*. It is also evident that the Brazilian record of *O. Claytoniana* may safely be dropped.

O. CINNAMOMEA AND ITS GEOGRAPHIC VARIETIES. *Osmunda cinnamomea* L., like *O. Claytoniana*, occurs in eastern America (Newfoundland to Georgian Bay, Ontario and Wisconsin, south to northern Florida, Alabama and Texas; with var. *imbricata* from the Bermuda Islands and Florida to Louisiana, south to tropical Mexico and Brazil) and *O. cinnamomea* is usually said to occur in eastern Asia (Amur, Manchuria and Sachalin Island to Yunnan). But just as the Eurasian *O. regalis* differs from the eastern American *O. regalis*, var. *spectabilis* in having black scale-like trichomes on the rachises of the fruiting panicle and the Himalayan *O. Claytoniana*, var. *vestita* differs from the eastern American plant in having much darker and more persistent wool, so the eastern Asiatic *O. cinnamomea* is at once distinguished from typical *O. cinnamomea* of temperate eastern America by having the tomentum of the stipes, rachises and fertile fronds rufescent, that of the fertile fronds with many black trichomes intermixed, the tomentum of typical *O. cinnamomea* being whitish-brown without any black admixture.

The plant of tropical and subtropical eastern America, O. CINNAMOMEA, var. IMBRICATA (Kunze) Milde, Mongr. Gen. Osmund. 95 (1868), has the tomentum more rufescent than in typical *O. cinnamomea* but it, likewise, lacks the black admixed trichomes of the Asiatic plant.

The three geographic varieties may be distinguished as follows:

O. CINNAMOMEA L., var. **typica.** *O. cinnamomea* L. Sp. Pl. ii. 1066 (1753). *Struthiopteris cinnamomea* (L.) Bernh. Schrad. Journ. 1800²: 126 (1801). *Osmundastrum cinnamomeum* (L.) Presl., Abh. Böhm. Ges. Wiss. ser. 5, v. 326 (1848).—Tomentum of stripes, rachises and fertile fronds whitish-brown: mature sterile pinnae 1.5–3.5 cm. broad, membranaceous, translucent; the veinlets scarcely elevated beneath.—Temperate eastern North America.

Var. IMBRICATA (Kunze) Milde, Mongr. Gen. Osmund. 95 (1868). *O. bipinnata* L. Sp. Pl. ii. 1065 (1753).[1] *O. imbricata* Kunze, Farnkr. ii. 29, t. cxii. (1849).—Tomentum brown to rufescent: mature sterile pinnae 1–2.3 cm. broad, subcoriaceous, opaque; the veinlets somewhat prominent beneath.—Tropical and subtropical eastern America.

Var. **asiatica**, var. nov., lamina fertili plus minusve nigricanti-villosa; stipitum rhachiumque vestimento rufescenti.—Amur, Man-

[1] *O. bipinnata* was published by Linnaeus on the page preceding the publication of *O. cinnamomea*. By those who accept the principle of "priority of position" *O. bipinnata* should be used instead of the more familiar *O. cinnamomea*.

churia and Sachalin Island to Yunnan; the following are characteristic. Amur: without designation of locality, *Maximowicz;* Amur medius, 1891, *S. Korshinsky* (type in Gray Herb.). Manchuria: between Mukden and Tungche-shien, 1886, *H. E. M. Jones.* Sachalin: without designation of locality, *Augustinowicz.* Japan: Hokodati, 1853–56, *J. Small* (U. S. No. Pacif. Expl. Exped.); Yokohama, 1862, *Maximowicz.*

It is perhaps not without interest to note that the very marked tendency of the Eurasian varieties of *Osmunda regalis, Claytoniana* and *cinnamomea* to have deeper-colored trichomes or darker and firmer scales than the eastern American plants is quite parallel with the situation in some other varieties or closely allied species of ferns. It has long been recognized that the Eurasian *Thelypteris spinulosa* (Muell.) Nieuwl. var. *dilitata* (Hoffm.) St. John has firm blackish scales on the stipe and that these often extend well along the rachis or even to the rachillas, while the eastern American representative, *T. spinulosa,* var. *americana* (Fischer) Weath. has thin and translucent soft and pale-brown scales which are more promptly deciduous.[1] Again, in European *Polystichum Braunii* "The largest scales of the stipe-bases . . . are rather firm . . . ; in the eastern American [var. *Purshii* Fernald] they are much thinner."[2] Other cases (European *Polypodium vulgare* L. and eastern American *P. virginianum* L., European *Asplenium Ruta-muraria* L. and eastern American *A. cryptolepis* Fernald; etc.) could be cited, in which species of eastern America and their representatives in Europe have apparent differences in the texture and often the depth of coloring of their scales. These characters are small but the scales seem to have evolved along quite definite lines on the two continental masses; and doubtless study of other ferns will bring to light parallel situations in other groups.

VI. POTAMOGETON ALPINUS AND P. MICROSTACHYS

M. L. Fernald

(Plate 197)

In 1827 Wolfgang, receiving material from the Aleutian Islands of a plant related to the European *Potamogeton alpinus* Balbis (1804) or *P. rufescens* Schrader (1815), proposed it as a new American species:

[1] For detailed discussion see Fernald, Rhodora, xvii. 45–47 (1915).
[2] Fernald, Rhodora, xxx. 29 (1928).

POTAMOGETON *microstachys W o l f g.;* caule simplici, tenui; foliis lineari-lanceolatis, subsessilibus, obtusiusculis, utrinque attenuatis, 5-nervibus: nervo medio crassiusculo, reticulato-venosis; stipulis internodia subaequantibus; pedunculis tenuibus, foliis brevioribus; spicis terminalibus, paucifloris. *W o l f g. Ms. n.* 15, *B e s s e r in litt.*

Specimina nostra, a cel. *Eschscholtz* in *U n a l a s c h k a* lecta, nondum sat evoluta, dum unicâ solum spicâ sint instructa, et caulis 8-pollicaris et internodia brevia; videntur ex aqua stagnante. Folia 4–5-poll., 2–3 lin. lata. *W o l f g.*[1]

At approximately the same time Chamisso,[2] apparently unaware of the conclusion of Wolfgang and discussing the pondweeds collected on the Romanzoff expedition, correctly defined *P. alpinus* (as *P. rufescens*) and showed in his illustrations (t. V. fig. 18) the distinctive fruit of the European plant, "Nux . . . stylo subapicali acuminata." In discussing the variations of the species Chamisso mentioned narrow-leaved and broad-leaved forms and under the "Forma angustifolia" the Unalaska material which was doubtless the basis of Wolfgang's *P. microstachys:*

Specimina, quae ipsi in stagnis frigidis insulae Unalaschca Aleutorum carpsimus, jam spicigera, nondum efflorata, huc non referre nequimus. Folia ad summum 4 pollicum longitudinem attingunt, 2–3 lin. lata, obtusa, septemnervia, nervo medio utriusque lateris paginae validiore. Internodia fere pollicaria. Spica brevis, pauciflora (nondum florens). Caulis spithamaeus. Folia natantia in nonnullis individuis jam incipientia. Semina non vidimus.[3]

Twenty years later, Alphonso Wood, getting into northeastern Vermont where the American plant which had already been described by Wolfgang and by Chamisso abounds, took it to be a new species and gave the first accurate account of its fruit, "subhemispherical, margined on the back, beak incurved." Wood's species was

P. OBRUTUS. Wood. *Lyndon Pond-weed.*

Lvs. glossy, linear-lanceolate, sessile, rather acute, only the midvein conspicuous, alternate, approximate, the lower stipules wanting; *spikes* long-pedunculate; *achenia* inflated, subhemispherical, margined on the back, beak incurved both sides, conspicuously umbilicate.—Passumpsic river, Lyndon, Vt.! A remarkable species, differing widely from any other with which I am acquainted. Stem round, slender, simple. Leaves uniform, 3–4′ by ½′, tapering to the slightly clasping base, the two upper opposite. Spike dense, 1½′ long, peduncle 3′ in length. Fruit with 2 little pits.[4]

But in spite of Wood's clear characterization of the fruit of the American plant, his species, *P. obrutus*, and Wolfgang's earlier *P.*

[1] Wolfg. in Schultes & Schultes, Mantissa, iii. 360 (1827).
[2] Cham. in Cham. & Schlecht. Linnaea, ii. 210-213, t. V, fig. 18 (1827).
[3] Cham. l. c. 211 (1827).
[4] Wood, Class-Bk. ed. 2: 525 (1847).

microstachys were quickly reduced and, so far as I can find, have never received the recognition they clearly merit. In 1856 Gray reduced to *P. lucens* L. an amazing number of species not then at all understood by him, *P. fluitans* Roth, *P. pulcher* Tuckerm., *P. amplifolius* Tuckerm. and *P. rufescens* Schrad., "a narrow-leaved form, with smaller fruit, &c., either without floating leaves (P. obrutus, *Wood*) or with them";[1] and this most unsatisfactory grouping was maintained by Gray until 1867. In that year Robbins's very clear and satisfactory differentiation of these species appeared,[2] but he still maintained *P. obrutus* as inseparable from *P. rufescens*. In 1893 Morong took up[3] in place of *P. rufescens* Schrad. the earlier name *P. alpinus* Balbis, but nowhere in his monograph did he mention either of the names, *P. microstachys* and *P. obrutus*, which had been given to supposedly distinct American species. Morong's plate, however, showed the characteristic fruit of the American plant, the "subhemispherical" fruit of Wood, with strongly rounded back and with very short beak at the summit of the ventral face; rather than the "Nux . . . stylo subapicali acuminata" of the European plant as correctly described and illustrated by Chamisso and as shown in such early European illustrations as Hornemann, Fl. Danica, ix. fasc. xxv. t. mccccl (1813) and x. fasc. xxviii. t. mdcxxxv (1819), Reichenbach, Ic. Crit. ii. t. clxxxiv (1824) and Fieber, Die Potamogeta Böhmens, t. i. fig. 4 (1838). Susbequent American authors have consistently followed Morong.

As already noted, Wolfgang and Chamisso, having young material "(nondum florens)," emphasized the narrower and few-nerved submersed leaves of the American plant; and in recent years some European students of *Potamogeton* have similarly commented upon a slight habital difference between the American and eastern Asiatic plant on the one hand, and true *P. alpinus* of Europe on the other but, so far as I can find, they have made no comparison of the mature fruits. Thus, in 1904, the late Arthur Bennett[4] published the following note:

> P. ALPINUS Balb. (*P. rufescens* Schrad.). On the receipt of a sheet of specimens of this species from the herbarium of Prof. Kinashi, of Japan, I was impressed by the dark colour (almost black), the narrow leaves, and the absence of floating leaves. On looking up my Asiatic and American specimens, I found that all the former were of the same tint, and lacked floating leaves; out of eleven American examples only one had any sign of them, and in the British Museum Herbarium they are present in only one example.

[1] Gray, Man. ed. 2: 435 (1856).
[2] Robbins in Gray, Man. ed. 5: 486, 487 (1867).
[3] Morong, Naiadaceae of N. Am.—Mem. Torr. Bot. Cl. iii. No. 2: 19, t. xxx (1893).
[4] Bennett, Journ. Bot. xlii. 72 (1904).

Dr. Robbins, in Gray's *Manual*, ed. 5, 486 (1879), says, "floating leaves often wanting (*P. obrutus* Woods)." These dark-coloured narrow-leaved forms are the *P. rufescens* "forma angustifolia" of Chamisso (*Linnaea*, ii. 211 (1827) = *P. microstachys* Wolfgang in Roem. & Schultes, *Mantissa*, iii. 360 (1827).

These specimens look very different from the forms named *P. nerviger* Wolfg. (*l. c.* 359) and those named var. *maximus* Mert. & Koch, Deutschl. Fl. i. 841 (1823), and were it not for the numerous connecting links might well be considered a distinct species.

Subsequently in *Das Pflanzenreich* Graebner, after giving the range of *P. alpinus*, added the "Nota 1. Specimina americana a me visa omnia angustifolia sunt";[1] and, taking his cue from Bennett's note already quoted, Graebner set up *P. alpinus*, proles *microstachys* (Wolfg.) Graebn., based on *P. microstachys* Wolfg., with *P. rufescens* "forma angustifolia" Cham. and *P. obrutus* Wood as synonyms. Proles *microstachys* was defined: "Folia submersa angustiora, fluitantia saepissime absunt. Planta exsiccata nigrescens" and its only geographic range was "Ostasien verbreitet," Graebner obviously overlooking the fact that the type of *P. microstachys* was from Alaska and of *P. obrutus* from Vermont.

In general, the American plants which pass as *Potamogeton alpinus* do have narrower or smaller leaves than the European plants. The commonest extreme of the American plant (*P. microstachys* or *P. obrutus*) has the submersed leaves linear-lanceolate and acute or subacute, only rarely obtuse, much resembling those of the larger extreme of *P. epihydrus* Raf. They range from 0.7–2.5 dm. in length and 5–15 mm. in breadth and have usually 7 primary nerves (sometimes only 5, rarely 9 or 11). The other extreme of the American series is less common, a plant with narrowly elliptic-oblong round-tipped or very obtuse submersed leaves 4–8 (rarely –12) cm. long, 0.8–2 cm. broad and 7–13-nerved. When fresh the plants of both varieties are reddish or a warm reddish-green and even in the dried condition they retain the red in the younger parts, but I can see no more black in them than in the European material before me. The leaves of the American series are certainly narrower or smaller than in the European. Our narrowest-leaved plant (*P. microstachys* or *P. obrutus*) is comparable with the narrowest-leaved plant of Europe (*P. alpinus*, var. *angustifolius* (Tausch.) Aschers. & Graebn.) but the foliage of the broader-leaved plant of Europe is much larger than in ours, "usque ad 2 dm fere longa et 2,5 cm lata" (*Graebner*) and mostly 15–17-nerved, and in forma *ovatifolius* Hagström even 3.5 cm. broad.

[1] Graebner in Engler, Pflanzenr. iv.[11]. 72 (1907).

During anthesis our plant has a decidedly moniliform spike with the flowers quite remote (Pl. 197, spike at right), but at the same stage of development the European series shows more continuous spikes (spike at left), the flowers more approximate than in ours. In young fruit the two are difficult to separate, but when the fruits are quite mature they show the marked contrast which was brought out in the descriptions earlier quoted from Chamisso's account of European *P. alpinus* and Wood's characterization of the American *P. obrutus:* the mature fruits of the European plants are narrowed and subequally attenuate to the prolonged submedian beak; those of the American and eastern Asiatic series broader, strongly rounded at the summit of the broad dorsal keel and laterally beaked at the summit of the ventral margin merely by a very short but often incurving style. The photograph (Plate 197), generously supplied by Dr. Hugh M. Raup and Mr. Albert N. Steward, shows a series of mature fruits (enlarged to 2 diameters), those of the European plant (with a flowering spike below) at the left (figs. 1–16), those of the American and eastern Asiatic (with a characteristic flowering spike below) at the right (figs. 17–37). These fruits, taken from every mature European specimen in the Gray Herbarium and from a fully representative series of the American plant, hold consistently to the differences already enphasized. Associated with marked geographic segregation, differences in the foliage and in the degree of crowding in the flowering spike, the essentially dissimilar fruits indicate that, when Wolfgang described the quite immature *P. microstachys* in 1827 and when Wood twenty years later accurately described the fruit of his *P. obrutus*, they were distinguishing from European *P. alpinus* a well defined American and eastern Asiatic species.

For a plant with mature spikes 1.5–3.5 cm. long and 7–10 mm. thick the name *Potamogeton microstachys* would be inexplicable except for the clear statements, already quoted, that the Unalaska type was not yet in flower "(nondum florens)." The implication of Wood's name *P. obrutus* and assertions by him and by European students that the American plant lacks or but rarely develops floating-leaves is almost as unfortunate: of the 195 flowering or fruiting specimens in the Gray Herbarium and the herbarium of the New England Botanical Club 86 lack floating leaves, 109 (a clear majority) have them.

As already stated, *Potamogeton microstachys* has two rather strongly defined variations. These are

Potamogeton microstachys Wolfg., var. **typicus.** *P. micro-*

stachys Wolfg. in Schultes & Schultes, Mantissa, iii. 360 (1827). *P. rufescens*, "Forma angustifolia" from Unalaska, Cham. in Cham. & Schl. Linnaea, ii. 211 (1827). *P. obrutus* Wood, Class-Bk. ed. 2: 525 (1847). *P. rufescens* Am. auth. in large part, not Schrad. *P. alpinus* Am. auth. in large part, not Balbis. *P. alpinis*, Proles *microstachys* (Wolfg.) Graebn. in Engler, Pflanzenr. iv[11]. 72 (1907).—Submersed leaves linear-lanceolate or narrowly lanceolate, acute or subacute to obtuse, 0.7–2.5 dm. long, 0.5–1.5 cm. broad, usually 7 (5–11)-nerved.—Southern Greenland and Labrador to Alaska, south to Newfoundland, Nova Scotia, Maine, western Massachusetts, New York, Michigan, Colorado, Utah and California. The following are characteristic specimens. GREENLAND: Qagssiarssuk, Igaliko-Fjord, 60° 53′ N., August, 1925, *Porsild & Porsild.* LABRADOR: Rama, *Stecker*, no. 332. NEWFOUNDLAND: Little Quirpon, *Wiegand & Hotchkiss*, no. 27,337; pools at 400–550 m., Lookout Mountain, *Fernald, Long & Fogg*, no. 1207; Grand Falls, *Fernald, Wiegand & Darlington*, no. 4474; Carbonear, *Fernald & Wiegand*, no. 4473; George's Pond, *Fernald & Wiegand*, no. 2443. QUEBEC: Natashquan, *St. John*, nos. 90,083, 90,084; Cap à l'Aigle, *J. Macoun*, no. 68,919; Black Lake, *Fernald & Jackson*, no. 11,987; Lac William, *Victorin*, no. 11,162; Sargent's Bay, Lake Memphremagog, August 3, 1903, *Churchill.* NEW BRUNSWICK: Connors, *Pease*, no. 2907. NOVA SCOTIA: Truro, *Bean & White*, no. 22,963. MAINE: St. Francis River, August 13, 1902, *Eggleston & Fernald;* Madawaska, *Fernald*, no. 117; Ashland, 1881, *Kate Furbish;* Monticello, *Fernald & Long*, no. 12,386; Veazie, September, 1897, *Fernald;* Milo, September 2, 1897, *Fernald;* Dover, August 27, 1894, *Fernald;* Sydney, *Fernald & Long*, no. 12,388; Rangeley, 1894, *Furbish;* Pembroke, *Fernald*, no. 1622. NEW HAMPSHIRE: Northumberland, *Robbins*, also *Pease*, no. 17,270; Pondicherry Pond, Jefferson, 1829, *Robbins;* Hanover, July 12, 1910, *Williams.* VERMONT: "e flumine Passumpsic," *A. Wood* (original collection of *P. obrutus*); West Barnet, 1880, *F. Blanchard.* MASSACHUSETTS: Richmond, September 19, 1864, *J. W. Robbins.* NEW YORK: creeks at foot of Lake George, *Tuckerman;* Dexter, *Fernald, Wiegand & Eames*, no. 14,082. ONTARIO: Current River, *J. Macoun*, no. 94. MICHIGAN: Isle Royale, *W. S. Cooper*, no. 254 in part. MANITOBA: near Cumberland House, *Drummond.* MONTANA: Shoshone Lake, *Rydberg & Bessey*, no. 3724 (distributed as *P. Zizii*). COLORADO: Georgetown, *M. E. Jones*, no. 734; Seven Lakes, *Clements*, no. 491; Lake Eldora, Boulder Co., *Clokey*, no. 3118 (as *P. praelongus*). UTAH: Alta, *M. E. Jones*, no. 1297; Big Cottonwood Canyon, August, 1904, *Garrett.* CALIFORNIA: Silver Valley, *Brewer*, no. 1978. WASHINGTON: Mt. Adams, 1879, *Suksdorf;* Trout Creek, *Suksdorf*, no. 2172. BRITISH COLUMBIA: Revelstoke, *J. Macoun*, no. 4163. ALASKA: Kadiak Island, *Trelease*, no. 2870; Unalaska (the TYPE-LOCALITY), *Van Dyke*, no. 202. SIBERIA: Krestovskoi Islands (at mouth of Kolyma River), sent by *Regel.* AMUR: Amur Medius, 1891, *Korshinsky.* JAPAN: Sapporo, 1903, *Arimoto.*

Var. **subellipticus**, var. nov., foliis submersis anguste oblongo-ellipticis 4–8(–12) cm. longis 0.8–2 cm. latis 7–13-nerviis apice rotundatis vel obtusis.—Newfoundland to British Columbia, south to Maine, Vermont, Michigan and Wyoming. Newfoundland: shallow pools in limestone barrens, Flower Cove, July 28, 1924, *Fernald, Long & Dunbar*, no. 26,221; *Hotchkiss*, no. 27,338; shallow pools, Stephenville, August 15, 1910, *Fernald, Wiegand & Kittredge*, no. 2442; pond 4 miles northeast of Port à Port, *Mackenzie & Griscom*, no. 10,047. Quebec: pool in tundra, Ile Ouapitagone, July 14, 1915, *St. John*, no. 90,085; ruisseau sur les dunes, Rivière Goynish, *Victorin & Rolland*, no. 18,575; étangs des tourbières calcaires, Ile à la Proie, Mingan, 20 juillet 1925, *Victorin & Rolland*, no 20,462; étangs calcaires, Grande Ile, Mingan, 20 juillet 1925, *Victorin & Rolland*, no. 20,468; eaux tranquilles, Riv. au Saumon, Anticosti, 3 août 1925, *Victorin, Rolland & Louis*, no. 20,467; Riv. Sainte-Marie, Anticosti, 2 août 1926, *Victorin & Rolland*, no. 25,938; shallow pools, Seal Cove River, Douglastown, August 22, 1904, *Collins, Fernald & Pease;* "Petit Bassin," Riv. Ste. Anne des Monts, August 17, 1906, *Fernald & Collins;* small pond on river-flat, Riv. Cap Chat, August 27, 1923, *Fernald & Smith*, no. 25,420; shallow pool, Bonaventure River, August 8, 1904, *Collins, Fernald & Pease;* brook, Georgeville, July 27, 1902, *Pease*, no. 1919. Magdalen Islands: shallow pools, Coffin Island, August 27, 1912, *Fernald, Long & St. John*, no. 6766 (type in Gray Herb.); étangs, Ile du Hâvre-au-Ber, 17 juillet 1919, *Victorin & Rolland*, no. 9923. Nova Scotia: cold shallow brook, Baddeck Bay, August 27, 1920, *Fernald & Long*, no. 19,687. Maine: rills, Houlton, July 13, 1916, *Fernald & Long*, no. 12,387; shallow brook, Foxcroft, September 5 and 15, 1894, August 31, 1896, *Fernald*, Vermont: pond near Willoughby Lake House, August 4 and 11, 1881, *Faxon*, June 10, 1895 and September 15, 1899, *Kennedy;* Nigger Pond, alt. 1750 ft., Westmore, August 3–10, 1916, *Eames & Godfrey;* Little Leech Pond, Averill, August 7, 1899, *Eggleston*, no. 1656. New York: Minerva Brook, east of Minerva, August 6, 1927, *House*, no. 15,182. Michigan: Eagle Harbor, Keweenaw Peninsula, 1863, *Robbins;* shallow ponds, Keweenaw County, August, 1890, *Farwell*, no. 514. Wyoming: Branch of Sweetwater, Wind River Mts., East Fork of Big Sandy, and Heart Lake Creek, 1878, *C. Richardson*. British Columbia: Kicking Horse Lake, August 17, 1890, *J. Macoun*.

Explanation of Plate 197

(All figures × 2)

Spike at left and Figs. 1–16, Potamogeton alpinus: 1, from Ballynahinch, Ireland, *ex Nat. Mus. Irel.;* 2, Shropshire, England, *Leighton;* 3, Savoie, *Perrier;* 4, Längenfeld, Tirol, *Zimmeter*, no. 2683; 5, Coburg, Bavaria, *Schack;* 6, Eversen bei Westerwalsede, Germany, *Buchenau;* 7, Thüringen, *Rehder;* 8, Bavaria, *G. Fischer*, no. 481; 9, Bavaria, *Fischer*, no. 482; 10, Bavaria, *Fischer*, no. 342; 11, Coburg, Bavaria, *Schack;* 12, Germany, *Sennholz;* 13, Bräcke, Jemtland, Sweden, *Tiselius*, no. 15k; 14, Ostrogothia (Linköping),

Sweden, *Ekeroth;* 15, Christiania (Oslo), Norway, *Blytt;* 16, Torne Lappmark, *Laestadius*.

Spike at right and Figs. 17–37, P. MICROSTACHYS: 1, from Carbonear, Newfoundland, *Fernald & Wiegand*, no. 4473 (var. *typicus*); 18, Flower Cove, Newfoundland, *Hotchkiss*, no. 27,338 (var. *subellipticus*); 19, Grand Falls, Newfoundland, *Fernald & Wiegand*, no. 4474 (var. *typ.*); 20, Stephenville, Newfoundland, *Fernald & Wiegand*, no. 2442 (var. *subel.*); 21, Natashquan, Quebec, *St. John*, no. 90,083 (var. *typ.*); 22, Magdalen Islands, *Fernald, Long & St. John*, no. 6766 (var. *subel.*); 23, Truro, Nova Scotia, *Bean & White*, no. 22,963 (var. *typ.*); 24, Madawaska, Maine, *Fernald*, no. 117 (var. *typ.*); 25, Foxcroft, Maine, *Fernald* (var. *subel.*); 26, Sydney, Maine, *Fernald & Long*, no. 12,388 (var. *typ.*); 27, Pembroke, Maine, *Fernald*, no. 1622 (var. *typ.*); 28, Willoughby, Vermont, *Kennedy* (var. *subel.*); 29, Richmond, Massachusetts, *Robbins* (var. *typ.*); 30, Lake George, New York, *Tuckerman* (var. *typ.*); 31, Minerva, New York, *House*, no, 15,185 (var. *subel.*); 32, Bruce Peninsula, Ontario, *J. Macoun;* 33, Eagle Harbor, Michigan, *Robbins* (var. *subel.*); 34, Heart Lake Creek, Yellowstone Region, *C. Richardson* (var. *subel.*); 35, Georgetown, Colorado (var. *typ.*); 36, Falcon Valley, Washington, *Suksdorf* (var. *typ.*); 37, Krestovskoi Islands, Siberia, *ex Regel* (var. *typ.*).

VII. THE IDENTITIES OF JUNCUS CANADENSIS AND OF J. BREVICAUDATUS

M. L. FERNALD

(Plate 198)

IN 1827 Jacques Gay published *Juncus canadensis* characterized by

> Panicula composita, erecta, plus minusve coarctata vel laxiuscula . . . ; spicis 4–8–16-floris, plus minusve distantibus vel approximatis, echinatis, fuscescentibus. Perigonii foliola lanceolato-linearia, substriata, acutè aristata, interiora sublongiora. Stamina tria, perigonio breviora; . . . . Capsula ellipsoideo-prismatica, triquetra, utrinque leviter attenuata, vix mucronata; . . . Semina utrinque in caudam albidam abeuntia.[1]

Gay's description indicated at least two elements, one with coarctate, the other with lax inflorescence, one with "spikes" 4–8-flowered, the other with more flowers (–15); but both had the perianth-segments acutely aristate, stamens 3, and seeds with a white tail at each end. The two elements were distinguished as

J canadensis. *Gay! ined.*

α. Culmo foliisque tenuibus, paniculâ sublaxâ, spicis 10–15-floris remotiusculis.

β. Culmo foliisque tenuibus, paniculâ coarctatâ, spicis 4–8-floris approximatis.

In 1866, Engelmann took up[2] *Juncus canadensis*, with three varieties: "α. *brevicaudatus* (J. acuminatus, Gray)," "β. *subcaudatus*, Con-

[1] J. Gay in Laharpe, Mon. Jonc. 134 (1827).

[2] Engelm. Trans. St. Louis Acad. ii. 436 (1866).

necticut to Georgia," and "γ. *longicaudatus* (J. paradoxus, Gray), Massachusetts southward to Louisiana, and north-westward to Minnesota"; and under var. "α. *brevicaudatus*" he named two forms, "A. *coarctatus*, Pennsylvania, northward and northwestward" and "B. *patulus*, Pennsylvania to Western New York & Ohio." Engelmann in 1866 gave no descriptions and all his names of that date were *nomina nuda* except *J. canadensis*, α. *brevicaudatus*, which was a renaming of *J. acuminatus* of Gray's Manual of that period (ed. 4), not of Michx., and *J. canadensis* γ. *longicaudatus*, which was a renaming of *J. paradoxus* of Gray's Man. ed. 4, not E. Meyer.

Two years later (1868) Engelmann[1] dropped the properly published name *J. canadensis* α. *brevicaudatus* and the *nomen nudum J. canadensis* α. *brevicaudatus* B. *patulus* of 1866 and recognized four varieties: (1) Var. α. *coarctatus* for the plant formerly called *J. canadensis* α. *brevicaudatus* (including the form "A. *coarctatus*") with the explicit synonymy, "*J. Canadensis*, β. Gay, l. c.; *J. acuminatus*, Torr. N. Y. 2, 327; Gray, l. c. 481; Chap. Fl. 464, et. Auct. Am. plur. non Michx."; (2) Var. β. *brachycephalus*, substituted for the earlier *J. canadensis*, α. *brecivaudatus* B. *patulus* and now for the first time described; (3) Var. γ. *subcaudatus*, now for the first time properly published; and (4) Var. δ. *longecaudatus* (the second syllable altered from the original *gi*), described in detail, with not only the original synonym *J. paradoxus* Gray, not Meyer, but the more significant synonym *J. canadensis* α. Gay. It is perfectly clear, then, that Engelmann, who had studied Gay's specimens, in his final revision identified Gay's *J. canadensis* α. with the plant Gray and others had been calling *J. paradoxus* and which Engelmann now called *J. canadensis*, var. *longicaudatus;* it is also quite as clear that Engelmann's *J. canadensis*, α. *brevicaudatus*, A. *coarctatus* (1866), changed in 1868 to *J. canadensis* var. α. *coarctatus*, was based upon and drew its final name from Gay's "*J. canadensis*, β. . . . paniculâ coarctatâ."

So far as I can find, the first formal taking up of *Juncus canadensis* Gay as standing without qualification for *J. canadensis* α. of Gay or var. *longicaudatus* Engelm. was by Coville in Britton & Brown's Illustrated Flora, i. 394, fig. 955 (1896). Coville's correct interpretation was accepted by me at the time I split off Gay's *J. canadensis* β. or *Engelmann's* var. *brevicaudatus* as a species, *J. brevicaudatus* (Engelm.) Fernald, Rhodora vi. 35 (1904); and it was again accepted by Coville in the second edition of the Illustrated Flora (1913); and

[1] Engelm. l. c. 474 (1868).

still again, by Coville & Blake, in 1918 when they separated off the last remaining of Engelmann's varieties as *J. subcaudatus* (Engelm.) Coville & Blake, Proc. Biol. Soc. Wash. xxxi. 45 (1918). It would thus seem, since Gay's vars. α and β were so definitely identified by Engelmann, who had studied the specimens, and since Coville had definitely taken up as true *J. canadensis* the plant which Engelmann had found to be Gay's var. α, while I had taken up *J. brevicaudatus* for the plant which Engelmann found to be Gay's var. β, that the proper names for these plants had been satisfactorily settled.

But recently Mr. K. K. Mackenzie has expressed[1] his personal dissatisfaction with the identifications others have made of Gay's *Juncus canadensis* α and β. He has secured from Paris photographs of such material of Gay's as could be found. "It will be seen . . . that all of the Canadian and Newfoundland material cited by Gay represents his variety β. They all represent the plant now generally called *Juncus brevicaudatus* (Engelm.) Fernald, as marked by Engelmann.

"The only material cited by Gay unaccounted for above is the Torrey material . . . Investigation at Paris did not result in finding any such material . . ."

Since there is, apparently, no extant material to stand unquestioned for Gay's *J. canadensis* α, Mackenzie's solution is to transfer the name *J. canadensis* to *J. canadensis* β. and he forthwith coins for the plant which Engelmann, Coville and I have identified as *J. canadensis* α the new combination *J. longicaudatus* (Engelm.) Mackenzie. At the same time, although admitting that "the name *J. brevicaudatus* (Engelm.) Fernald . . . can logically be used as in our current manuals," Mackenzie believes it "would be the best course" to interpret *J. brevicaudatus* as based on material of *J. brachycephalus* (Engelm.) Buchenau.

In regard to the last suggestion it should be noted that *J. brevicaudatus* goes directly back to *J. canadensis*, "α. *brevicaudatus* (J. acuminatus, Gray)" of Engelmann (1866); in other words it was *J. acuminatus* of Gray's Manual, ed. 4 (1865). The salient points in Gray's description were "*Stem erect* (10′–15′ high) . . . *panicle with rather slightly spreading branches, bearing few or many* 3–8-*flowered chestnut-colored heads;* sepals lanceolate or linear-lanceolate, very acute, one third or one half the length of the prismatic triangular and abruptly acute pod; *seeds tail-pointed* at both ends. . . . Peat-bogs, and sandy borders of ponds." Mackenzie believes it "would be

[1]Mackenzie, Bull. Torr. Bot. Cl. lvi. 29–32 (1929).

the best course" to interpret *J. canadensis* α. *brevicaudatus* Engelm. (1866) as meaning his forma B. *patulus*, rather than his forma A. *coarctatus*. As already noted, Engelmann in 1868 took up var. *coarctatus* in place of his earlier *J. canadensis* α. *brevicaudatus* (and its forma A. *coarctatus*), while he substituted for α. *brevicaudatus* B. *patulus* of 1866 the new name var. *brachycephalus*, which is the basis of *J. brachycephalus* (Engelm.) Buchenau. Engelmann correctly described the latter as having "culms 1½–2½ feet high; panicles effuse, with spreading branches; sepals mostly obtuse; capsules obtusish and mucronate, short-exserted (caulibus elatioribus (1½–2½ pedalibus) . . . ; paniculae majoris effusae ramis patulis; . . . sepalis plerumque obtusis; . . . capsula . . . obtusiuscula mucronata breviter exserta)." How different was Gray's description of his *J. acuminatus* upon which alone the original *J. canadensis* α. *brevicaudatus* Engelm. (1866) rests: "*Stem erect* (10′–15′ high) . . . ; *panicle with rather slightly spreading branches* . . . ; sepals . . . very acute, one third or one half the length of the prismatic triangular and abruptly acute pod." Gray's description in English was closely paralleled by Engelmann's description in Latin in 1868 of his var. *coarctatus* which he was then substituting for his earlier var. *brevicaudatus:* "(½–1½ pedalibus) erectis; paniculae minoris coarctatae ramis erectis; . . . sepalis acutis seu raro obtusiusculis; . . . capsula . . . acutata longius exserta." Neither Engelmann, Gray, Coville, Buchenau nor any one else who understood the genus had any thought of confusing *J. acuminatus* Gray, not Michx. with *J. brachycephalus*. There are only a few specimens of this group in the Gray Herbarium dating back to 1865 and thus showing what Gray was calling *J. acuminatus* just prior to Engelmann's publication of *J. canadensis*, "α. *brevicaudatus* (J. acuminatus, Gray)." In *J. brachycephalus* there are 4 specimens: from Erie Co., New York, *A. Gray*, without an original identification but marked by John Carey "*J. acuminatus?*"; from Penn Yan, New York, *Sartwell* and from Dexter, New York, *Vasey*, the Sartwell specimen without name, the Vasey one originally called *J. paradoxus*, changed to *J. pelocarpus?*, and both marked by Carey "*J. acuminatus? capitulis parvis*"; a sheet from Jefferson Co., New York, *Vasey*, labeled *J. articulatus;* all of the specimens relabeled by Engelmann *J. canadensis* β. *brachycephalus*. Of *J. brevicaudatus* (Engelm.) Fern. or *J. coarctatus* (Engelm.) Buchenau there are likewise 4 of these older specimens: Essex Co., Massachusetts, *Oakes*, without name except in Engelmann's hand

"*J. canadensis* Gay, α. *brevicaudatus*, γ. *coarctatus*, G. E. 1866," the second name with a later pen-line through it; White Mts., New Hampshire, *Gray*, similarly without name on original label but marked by Engelmann as above; and two numbers (3 and 4) sent by Vasey from Dexter, New York as "*Juncus accuminatus*" and so accepted by Gray who made memoranda as to the source of the specimens and corrections of Vasey's unfortunate spelling; and these, like the others were marked by Engelmann *J. canadensis* var. *coarctatus*. It is thus unclear that the only plants Gray had before him which bore the unquestioned name *J. acuminatus* were specimens which Engelmann at first called *J. canadensis*, var. *brevicaudatus*, forma *coarctatus*, later var. *coarctatus*. That *J. acuminatus* of Gray, consequently *J. canadensis* α. *brevicaudatus* Engelm., therefore *J. brevicaudatus* (Engelm.) Fernald, is the plant Fernald meant when he transferred the name there can be no serious question.

As to Mackenzie's other contention, that in the absence of any identifiable type of Gay's *J, canadensis* α, the name *J. canadensis* should be used for his var. β. because the first specimen mentioned by Gay happens to belong to that plant, of course the International Rules of Nomenclature provide that "When a species or subdivision of a species is divided into two or more groups of the same nature, if one of the two forms was distinguished or described earlier than the other, the name is retained for that form" (Art. 47). It is, consequently, logical to accept the "alpha variety" as the type of a complex species; and when the var. β. was taken out as the coördinate species, *J. brevicaudatus*, naturally var. α was interpreted as *J. canadensis*.

Even though no extant specimen of Gay's *J. canadensis*, var. α can be found, Gay (or Laharpe) furnished a very vivid comparative note which Mackenzie did not quote. After the description of *J. canadensis* occurs this comment: "La variété α ressemble au *J. lampocarpos* γ, tandis que la variété β a le port du *J. ustulatus*." *J. lampocarpus* is the plant we call *J. articulatus* L. and *J. lampocarpus* γ of Laharpe is the extreme with "Spicis paucis, multifloris, densis, culmo foliisque duris,"[1] i. e. *J. lampocarpus*, var. *macrocephalus* (Viv.) Döll. An inflorescence of this plant, which Laharpe stated that *J. canadensis* var. α of Gay resembles, is shown in PLATE 198, FIG. 1, from a specimen collected in Hyères (*Raine*), and beside it (FIG. 2) is a panicle of the American plant which Engelmann, Coville and I have

[1] Laharpe, Mon. Jonc. 125 (1827).

identified as Gay's *J. canadensis*, var. α. In the absence of a type-specimen, Laharpe's note of the resemblance of the two is certainly pretty conclusive and little good can come by replacing this well-grounded interpretation by a new guess which at best simply shifts the names without adding anything of finality to the solution.

Juncus ustulatus Hoppe is treated by Buchenau, Rouy and other competent European students as one of the varieties of *J. alpinus* Vill. A characteristic inflorescence of this variety of *J. alpinus* (*J. ustulatus*) is shown in FIG. 3 (*Braun-Blanquet*, Fl. Raet. Exsicc. no. 318) and beside it a typical inflorescence of *J. brevicaudatus* (Engelm.) Fernald as FIG. 4 (Bathurst, New Brunswick, *S. F. Blake*, no. 5440). The pertinence of the original statement that Gay's *J. canadensis* β has the aspect of *J. ustulatus* is apparent. It should be clear, then, that when Engelmann stated that his *J. canadensis*, var. *brevicaudatus*, later called by him var. *coarctatus*, was Gay's *J. canadensis*, var. β, he had positive grounds for his identification and that when he originally based var. *brevicaudatus* upon Gray's *J. acuminatus* he was correctly associating the latter with *J. canadensis*, var. α of Gay. There is, then, no reasonable justification for shifting *J. brevicaudatus* to the synonymy of *J. brachycephalus*, as supposed by Mackenzie.

EXPLANATION OF PLATE 198

(All figures × 1)

Panicles of (FIG. 1) JUNCUS LAMPOCARPUS γ Laharpe (var. MACROCEPHALUS (Viv.) Döll) from La Plage, Hyères, France, *F. Raine;* (FIG. 2) J. CANADENSIS J. Gay from Chilmark, Massachusetts, *F. C. Seymour*, no. 1147; (FIG. 3) J. USTULATUS Hoppe (J. ALPINUS, var. MUCRONIFLORUS (Clairv.) Aschers. & Graebn.) from the Central Alps, *Braun-Blanquet*, Fl. Raet. Exsicc. no. 318; (FIG. 4) J. BREVICAUDATUS (Engelm.) Fernald from Bathurst, New Brunswick, *S. F. Blake*, no. 5440.

THE POLLINIZATION OF HABENARIA OBTUSATA.—The small, greenish white orchid, *Habenaria obtusata* (Pursh) Richardson, is a common plant of the Canadian forest from Newfoundland to Alaska. In the Athabaska-Great Slave Lake region of northwestern Canada it is not only extremely abundant, as shown by the writer's collections and observations, but it is also by far the most common of all the orchids growing there. On several occasions during the past three summer's botanizing in this region, mosquitoes have been found carrying the pollinia of this orchid, the sticky pads of the pollinia